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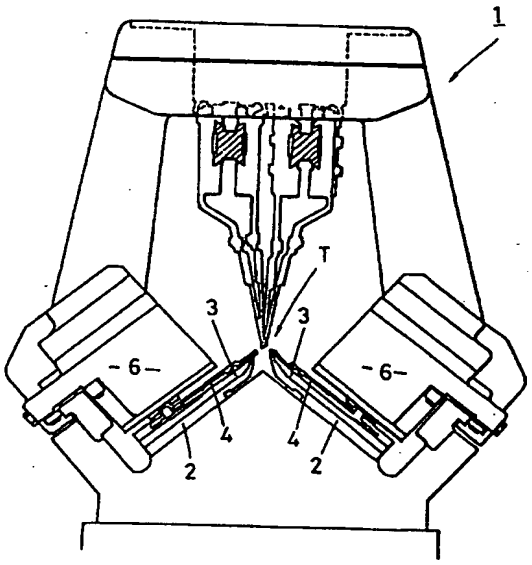
(54) Flat bed knitting machine with movable yarn guide members.

(57) A flat knitting machine incorporating movable yarn guide members has a pair of needle beds (2) disposed in front and rear alignment and a plurality of needle plates (3) provided for each needle bed (2) at equal intervals. The pair of needle beds (2) are disposed in front and rear alignment so that said tip portions of the needle plates (3) are close to each other. A plurality of knitting needles (4) are aligned in parallel between the needle plates (3). The knitting needles (4) are compound needles in which sliders are projecting and retracting via a carriage (7). There are provided a plurality of movable sinkers (7) each of which is swingably held at a position close to tip end of each needle plate (3) and is provided with an elastically energizing member for generating energizing force by which a knitting yarn held in knitting-yarn pressing portion formed at tip portion of each movable sinker is energized in the direction of pressing knitting yarn. Each yarn guide member is provided between a needle plate and a knitting needle, with each yarn guide member is slidably disposed so that guide surface formed at the tip thereof can project and retract itself from the tip of each needle bed. An operating member is provided at rear-end portion of each yarn guide member and projecting and retracting by a control means secured to a carriage.

Fig.1



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BACKGROUND OF THE INVENTION

The present invention relates to a flat-knitting machine, more particulaly, to a flat-knitting machine incorporating a plurality of movable yarn guide members respectively capable of guiding knitting yarns fed to tip portions of needle heads up to predetermined positions of knitting needles.

Applicant of the present invention previously proposed a flat knitting machine of analogous kind which was disclosed in the European Patent Publication No. 0 441 564 A2 (corresponding to European Application No. 91300874. 4).

The flat knitting machine disclosed in the above European Patent Publication incorporates a pair of needle heads which are respectively disposed in the front and rear alignment and respectively incorporates a projectable and retractable compound needle by permitting tip portions of respective needle heads to come close to each other. Swingable sinkers are respectively held at the tip portion of the approaching needle heads. Each movable sinker has a hook portion for pressing a sinker loop and a guide surface for guiding a knitting yarn fed to upper portion of the pressing hook up to a predetermined position of a knitting needle. Each sinker is arranged to swing itself by means of a cam unit of carriage.

Nevertheless, since each movable sinker having guide surface for guiding a knitting yarn provided for the flat knitting machine described in the above Europearn Patent Publication is compulsorily driven for swinging, when sinker loops have different sizes for example, operator needs to adjust swingable amount of the movable sinker in correspondence with actual size of minimum loop.

To solve this problem, as was disclosed in the European Patent Publication No. 0 435 690 A2 (corresponding to European Application No. 90314390. 7), the Applicant of the present invention further proposed a flat-knitting machine having an energizing means for pressurizing sinker loops (provided for each sinker-loop pressing hook of each movable sinker) in the direction of pressing the sinker loops. The proposed mechanism was conceived to press sinker loops via substantially constant tension using elastic energizing force of the energizing means even when sinker loops have different sizes.

Nevertheless, since swingable amount of each movable sinker is dependent on actual size and tension of corresponding sinker loop, when guide surface for guiding a knitting yarn is provided on the sinker-loop pressing hook portion, it causes the position of the guide surface of the movable sinker to become variable, thus resulting in the failure to optimally position the yarn guide surface.

Furthermore, according to the flat-knitting machine described in the European Patent Publication No. 0 441 564 A2 (corresponding to European Application No. 91300874. 4), the movable sinkers cannot swing themselves for a substantial amplitude in that pressing amount is preset in order that sinker loops cannot be cut off even when the sinker loops pressed by the sinker-loop pressing hook portion are quite small while the movable sinkers are compulsorily driven for swinging by carriages, and in that, since the guide surface is formed on the sinker-loop pressing hook portion, when each movable sinker on one of a pair of needle beds set in the front and back alignment with their tip portions being close to each other is subjected to swinging for a substantial amplitude, the swinging movable sinker interferes with a movable sinker on the other needle bed or the tip portion of the other needle bed, thus raising problem.

The invention has thus been proposed to fully solve the above problems. The object of the invention is to provide an improved flat-knitting machine capable of correctly pressing sinker loops with optimum tension and guiding supplied knitting yarns into hooks.

SUMMARY OF THE INVENTION

To achieve the above object, the improved flat-knitting machine incorporating movable yarn guide members comprises:

at least a pair of needle beds disposed in front and rear alignment;

a plurality of needle plates provided for each needle bed at equal intervals;

wherein the at least pair of needle beds are disposed in front and rear alignment so that said tip portions of the needle plates are close to each other,

a plurality of knitting needles aligned in parallel between the needle plated;

wherein the knitting needles are compound needles in which sliders are projecting and retracing via a carriage,

a plurality of movable sinkers each of which is swingably held at a position close to tip end of each needle plate and is provided with an elastically energizing member for generating energizing force by which a knitting yarn held in knitting-yarn pressing portion formed at tip portion of each movable sinker is energized in the direction of pressing knitting yarn; characterized in that:

each yarn guide member is provided between a needle plate and a knitting needle, wherein each yarn guide member is slidably disposed so that guide surface formed at the tip thereof can project and retract itself from the tip of each needle bed; and

an operating member is provided at rear-end portion of each yarn guide member and projecting and retracting by a control means secured to a carriage.

Further, upper half of lateral surface close to the tip of each needle plate is thinly formed, semispheri-

cal supporting recess is formed in thick lower half portion substantially at the middle of the thinly formed lateral surface thereof, a rotary support member of a movable sinker is engaged with the semispherical supporting recess, each yarn guiding member is slidably positioned at lateral portion of the rotary support member, and a knitting needle is stored in slit-like space formed below a needle plate spacer at the lower half portion of lateral surface of the needle plate.

Furthermore, cam groove of a control cam is formed in order that each yarn guide member will not overrun the center line of teeth apertures of the needle beds provided in the front and rear alignment when the yarn guide members are driven to the farthest position.

Furthermore, cam groove of a control cam is formed so that the tip of the yarn guide member retreats to a position free from causing interference with yarn supply aperture while yarn supply aperture of a yarn feeder passes therethrouth only when the yarn guide member is driven in the forward direction.

According to the improved flat-knitting machine incorporating the inventive movable yarn guide members, whenever a carriage accompanied with a yarn feeder runs over a needle head, a movable sinker, a yarn guide member, and a knitting needle, are operated by cam units stored in the carriage.

Concretely, the movable sinker is properly driven for swinging by a sinker-cam to cause sinker loops to be pressed against a sinker-loop pressing hook portion.

When this condition is entered, availing of energizing force of an elastically energizing member set to movable-sinker swing support portion, knitting yarns held by a yarn pressing portion are energized in the yarn-pressing direction. When sinker loops have negligible size, or when tension of sinker loops abnormally rises in the course of effecting relative shift of the front and rear needle beds to shift meshes back and forth in order to form desired pattern or increase or decrease meshes, the elastically energizing member bends itself in the direction of loosening tension of sinker loops to prevent them from being elongated or cut off.

Next, yarn guide members and knitting needles are driven in the forward direction by a predetermined amount by cams of a carriage. When laterally viewing yarn feeding position at which hook of slider of each knitting needle remains open, tip portion of the slider is at a position without projecting itself from guide surface portion of the yarn guide members towards hook portion. Since each of supplied knitting yarns is securely delivered to the hook after being guided through the guide surface, the knitting yarns can proceed linearly without being caught by the slider used for closing hook of each knitting needle.

Since the cam groove of the control cam is so formed that the yarn guide members can be prevented from overrunning the center line of teeth apertures of the needle beds disposed in the front and rear alignment when the guide members are driven to the farthest position, the front and rear needle beds can be shifted relatively without causing the yarn guide members of the front and rear needle beds to interfere with each other.

Furthermore, since the tip portion of each yarn guide member is so formed that it can retract itself while the proceeding yarn guide member passes through yarn supply aperture of a yarn feeder, the yarn supply aperture of the yarn feeder remains free from coming into contact with the yarn guide member.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a lateral view of fundamental components of the improved flat knitting machine according to the invention;

Fig. 2 is a sectional view of disassembled components of the movable yarn guide member according to the invention;

Fig. 3 is a lateral view of knitting needles conforming to compound needle;

Fig. 4 is an expanded view of cam group of a carriage;

Fig. 5 is an expanded view of a cam for controlling a movable sinker;

Fig. 6 is a sectional view of knitting needle portion taken on line X-X shown in Fig. 8;

Fig. 7 is a lateral view of knitting needle portion when a specific knitting needle is at position A shown in Fig. 4;

Fig. 8 is a lateral view of kniting needle portion when a specific knitting needle is at position B shown in Fig. 4;

Fig. 9 is a lateral view of knitting needle portion when a specific knitting needle is at position C shown in Fig. 4;

Fig. 10 is a lateral view of knitting needle portion when a specific knitting needle is at position D shown in Fig. 4;

Fig. 11 is a lateral view of knitting needle portion when a specific knitting needle is at position E shown in Fig. 4; and

Fig. 12 is a lateral view of knitting needle portion when a specific knitting needle is at position F shown in Fig. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the accompanying drawings, details of the improved flat-knitting machine incorporating the movable yarn guide members according to an embodiment of the invention are described below.

Fig. 1 is a lateral view representing schematic structure of fundamental components of the im-

proved flat-knitting machine according to the invention, in which the reference numeral 1 designates an overall view of the improved flat-knitting machine. The improved flat knitting machine 1 incorporates a plurality of needle plates 3 shown in Fig. 2 which are respectively installed above corresponding needle beds 2 at equal intervals. A plurality of compound-needle type knitting needles 4 and yarn guide members 5 shown in Fig. 3 are installed in parallel between the needle plates 3 and 3 by way of individually capable of projecting and retracting themselves. The needle beds 2 are disposed in opposition from each other in the "Λ" shaped formation via lateral view as of the condition in which tip portions of the knitting needles 4 are close to each other. A plurality of movable sinkers 7 respectively being swingable by a carriage 6 are disposed at the tip portions of the needle beds 2.

Space T is formed between tip ends of the needle plates 3 and 3 through which knitting needles 4 of the needle beds 2 and the yarn guide members 5 are projectively and retractably operated by the corresponding carriages 6.

Fig. 4 schematically illustrates a cam group of a carriage 6 for projecting and retracting knitting needles 4 of a needle head 2 and swinging a plurality of movable sinkers 7. The reference numeral 8 shown in Fig. 4 designates a knitting cam, 9 a rear cam for controlling sinkers disposed in front of the knitting cam 8, 10 a front cam for controlling sinkers disposed in front of the rear cam 9, and the reference numeral 11 desisnates a control cam for projecting and retracting yarn guide members 5.

The sinker-controlling front cam 10 consists of a cam profile 12 formed below a piece of plate. As shown in Fig. 5, the sinker-controlling rear cam 9 comprises a pair of rotatable cams 13a and 13b disposed to the left and to the right of a piece of plate which forms a cam profile 13 on the bottom surface of the rear cam 9 and a connection rod 17 which causes either of the rotatable cams 13a and 13b of movable sinkers 13a and 13b to retract when the other cam 13a or 13b projects. A sliding cam 13c is provided between the rotatable cams 13a and 13b. As shown in Fig. 7, the sinker-controlling front cam 10 and rear cam 9 are respectively secured to a bracket 14 projecting from the carriage 2 via bolts 15 and 16. The sliding cam 13c shifts itself to downstream side in the carriage moving direction as soon as it comes into contact with a contact portion 25b of a rear cam of a movable sinker. The rotatable cam 13a is forwardly operative, whereas the other cam 13b is backwardly operative.

As shown in Fig. 4, the knitting cam 8 comprises a needle-raising cam 19, a crown member 20 disposed in the center tip of the needle-raising cam 19, a pair of gradational members 21 and 21 which are slidably disposed along both sides of the crown member 20, and a control groove 23 formed between the needle-raising cam 19, the crown member 20, and the gradational members 21 and 21 to permit butts 22 of respective knitting needles 4 to pass therethrough.

The butt 22 of individual knitting needle 4 is controlled by the knitting cam 8. As shown in Fig. 3 and Fig. 6, the needle plates 3 are respectively secured to the upper surface of the needle bed 2. A hook 4a at the tip of each knitting needle 4 is slidably disposed between the needle plates 3, 3, 3 ··· so that the hook 4a can externally project from the tip of the needle bed 2 and retract itself. When individual butt 24a of a slider 24 is operated by a slider control cam (not shown) in association with projecting and retracting movements of each knitting needle 4, the slider 24 opens and closes the hook 4a. A plurality of ship-shaped (plane view) blades are provided on a side of respective knitting needles 4 in order to expand loops.

A plurality of needle-plate spacers 18 are respectively set above individual knitting needles 4 and yarn guide members 5 secured between the needle plates 3, 3, 3.

As shown in Fig. 2, the movable sinker 7 comprises a thinly formed sinker plate 25 having the front being bent by way of circular arc and a sinker-loop pressing hook portion 27 formed on the part of the tip of the sinker plate 25. Front-cam contact portion 25a permitting contact of the sinker-controlling front cam 10 therewith is formed slightly behind the sinker-loop pressing hook portion 27. A spring holder 30 is formed near the front-cam contact portion 25a in order to secure an end of a substantially U-shaped linear spring (elastically energizing member) 29 which downwardly presses to energize the sinker-loop pressing portion 27.

A rotation support portion 31 is formed below the spring holder 30 of the sinker plate 25 by way of semicircularly projecting itself. Rear-cam contact portion 25b permitting contact of the rear cam 9 therewith is formed at the rear end of the sinker plate 25.

Upper half portion of a lateral surface close to the tip of the needle plate 3 attached with the sinker plate 25 is thinly formed by scraping off thick portion consisting of the sinker plate 25 and the yarn guide member 5. Semicircular recess 33 is formed in the lower half portion of the thick portion at the middle of the thinly formed portion. The semicircular recess 33 accommodates a rotation support member 31 of the sinker plate 25. The remaining portions of the sinker plate 25 are accommodated between the thinly formed portion of the needle plate 3 and the needle plate spacers 18. The yarn guide members 5 are accommodated between the needle plate spacers 18 at the lower part of the sinker plate 25. Knitting needles 4 are slidably stored in the lower-half side portions of the needle plate 3 below the needle plate spacers 18.

Each of the needle plate spacers 18 is formed with a thinly formed steel sheet. Coupling recesses 46

coupled with respective rotary rods 45 held across the needle plates 3, 3, ··· are respectively formed in the rear end portion of the needle plate spacers 18. Central upper surface portion of each needle plate spacer 18 has such a shape analogous to the upper half portion of the needle plate 3 having a dovetailed coupling groove 37 to be described later on.

As shown in Fig. 2, each of the yarn guide members 5 has a guide surface 42 which is downwardly inclined in the oblique direction at the tip end of the main body 41 formed with a thinly formed narrow-width steel sheet. A slide guide member 40 accommodating a pair of grooves 43 formed in the upper and lower ranks for slidably being guided by the rotary rod 45 held across the needle plates 3, 3, ·· is formed at the rear end of the main body 41. Individual butt 44 is vertically set to the upper surface of the slide guide member 40, where each butt 44 is operated for projecting and retracting itself by the control cam 11 secured to the carriage 6.

As shown in Fig. 4, the control cam 11 for causing each yarn guide member 5 to project and retract by operating the butt 44 incorporates a cam groove 48 for permitting the yarn guide member 5 to internally proceed and externally retreat at both ends and center portion thereof at intermediate height position of a cam plate 47.

When a pressing plate 38 is inserted in coupling grooves 37 formed in respective upper surfaces of the needle plates 3 and the needle-plate spacers 18, the needle plate spacers 18 are fixed. Simultaneously, free-end portion 29a of the linear spring 29 is depressed so that it can be energized by own tension under the pressing plate 38, thereby causing the sinker-loop pressing hook portion 27 at the tip portion of the sinker plate 25 to be depressed and energized constantly.

Next, operation of the improved flat knitting machine incorporating the movable yarn guide members according to the invention is described below by way of exemplifying a knitting needle 4A.

When the carriage 6 shifts itself from the left to the right to fix a knitting needle 4A at position A shown in Fig. 4, as shown in Fig. 7, butts 22 are operated by gradational cams 21 to cause the hook 4a at the tip of the knitting needle 4A accompanying loop to retract to a position substantially corresponding to the tip of the needle plate 3.

The rear-cam contact portion 25b of the movable sinker 7 is depressed by the movable cam 13a of the rear cam 9. On the other hand, the sinker plate 25 rotates counterclockwise in resistance against tension of the linear spring 29 by way of pivoting on the rotary member 31 coupled with the recess 33 to cause the sinker-loop pressing hook portion 27 at the tip portion of the sinker plate 25 to be positioned above the knitting needle 4A, thereby causing the movable cam 13a of the rear cam 9 to become no longer effective in acting on the rear cam contact portion 25b of the movable sinker 7. This in turn causes the sinker plate 25 to rotate clockwise by effect of tension of the linear spring 29 to permit deleivery of knitting yarns between the knitting needles 4A, 4, ··· to the sinker-loop pressing hook portion 27, which then depresses the delivered knitting yarns to cause the knitting yarns between the knitting needles 4A, 4, ··· to be depressed by effect of proper pressing force generated by tension of the linear spring 29.

Next, when the knitting needle 4A is shifted to position B shown in Fig. 4 from position A as the carriage 6 shifts itself, butt 22 of the knitting needle 4A is pushed upward by the needle raising cam 19 while maintaining condition in which knitting yarns between the knitting needles 4A, 4, ··· are held by the sinker-loop pressing hook portion 27, thereby causing hook 4a of the knitting needle 4A to significantly project itself from the tip of the needle bed 2. When this condition is present, even though the knitting needle 4A significantly projects itself, since butt 24a of the slider 24 is slightly lifted by a slider control cam (not shown), the hook 4a of the knitting needle 4A is opened, thereby enabling loop held by the hook 4a to be lifted above the slider 24. Simultaneously, butt 44 of the movable yarn guide member 5 is retracted via cam groove 48 of the control cam 11, and as a result, tip end of the butt 44 becomes substantially flush with the tip end of the sinker plate 25 as shown in Fig. 8.

Even when tension of knitting yarns between the knitting needles 4A, 4, ··· held by the sinker-loop pressing hook portion 27 is intensified when the loop held by the hook 4a ascends above the retracted slider 24, in response to intensified tension, since the sinker-loop pressing portion 27 swings itself upward in order to absorb the intensified tension, the loop lifted above the slider 24 is prevented from exessively being elongated or torn off.

Next, when the carriage 6 further shifts itself to the left to permit the knitting needle 4A to shift itself to position C shown in Fig. 4, while the butt 44 of the yarn guide member 5 is retracted via the cam groove 48 of the control cam 11, the butt 22 of the knitting needle 4A is operated by the crown cam 20 to enable the knitting needle 4A to descend itself.

While the above condition is present, since the butt 24a of the slider 24 remains without totally descending itself, the loop lifted above the slider 24 at position B is retained above the slider 24. Simultaneously, as shown in Fig. 9, knitting yarns are delivered to the hook 4a from yarn feeder 50 shifting in conjuction with the carriage 6. While this condition is present, since the butt 44 is retracted via the cam groove 48 of the control cam 11, yarn feeding aperture 50a of the yarn feeder 50 can pass through the yarn guide member 5 without coming into contact with the tip end of the yarn guide member 5.

When the carriage 6 further proceeds to the left

to shift the knitting needle 4A to position D shown in Fig. 4, the knitting needle 4A descends furthemore. On the other hand, the butt 44 is pushed forward via the cam groove 48 of the control cam 11 to cause the yarn guide member 5 to project itself from the tip of the needle head 2.

As a result of external projection of the yarn guide member 5, each knitting yan is delivered to the knitting needle 4 from the yarn feeder 50 at position C and then led below sliding locus of the slider 24 via the pronely inclined guide surface 42 at the tip of the yarn guide member 5. Knitting yarn is then deleivered to the yarn feeding aperture 50a and then securely led to inner space of the hook 4a of the knitting needle 4 (see Fig. 10).

When the carriage 6 further proceeds to the left until the knitting needle 4A arrives at position E shown in Fig. 4, since the butt 22 of the knitting needle 4A is sbstantially lowered by the gradational cam 21, the slightly descending slider 24 closes the hook 4a holding the supplied knitting yarn. Next, as shown in Fig. 11, the loop (the former one) mounted on the upper surface of the slider 24 is knocked over in ssuch a state in which both sides of the hook 4a are held between he lower portion of the guide surface 42 of the yarn guide member 5 and the upper portion of the guide surface 42 of the yarn gguide member 5 and the upper portion of the sinker-loop pressing hook portion 27 of the movable sinker 7. While this condition is present, although the movable sinker 7 is apt to be lifted by tenssion of knitting yarn, the front cam 10 securely holds the movable sinker 7. Accordingly, as shown in Fig. 11, when the knitting needle 4A fully descends, mesh of the loop is formed.

When the carriage 6 further proceeds to the left until the knitting needle 4A arrives at position F shown in Fig. 4, the butt 22 of the knitting needle 4A is pushed to a position slightly above the bottom edge portion of the gradational cam 21, thereby causing the butt 44 of the yarn guide member 5 to be provisionally lowered by the cam groove 48 of the control cam 11 from the state E described above before eventually being released from the cam groove 48. In consequence, as shown in Fig. 12, tip portions of the yarn guide member 5, the movable sinker 7, and the knitting needle 4A, are at the substantially identical position.

In this way, operation for knitting a knit is executed by repeating the above proccesses. In order to form desired pattern or solid silhouette, while the knitting operation is underway with the flat-knitting machine incorporating a pair of needle beds 2 and 2 aligned in the front and on the back according to the above embodiment, the needle beds 2 and 2 are mutually shifted to shift mesh. Even when executing the knitting operation, swinging locus of the movable sinker 7 does not overrun the center line C of teeth aperture between the front and rear needle beds 2 and 2, and yet, even when the yarn guide member 5 projects itself by a maximum range, it does not overrun the center line C of the teeth aperture, and thus, when the needle beds 2 and 2 shift themselves in order to prevent tip ends of the yarn guide member 5 and the movable sinker 7 on one side from interferring with tip ends of the yarn guide member 5 and the movable sinker 7 of the other side, both the yarn guide members 5 and the movable sinkers 7 are free from incurring damage.

The above embodiment has solely referred to provision of a pair of needle beds 2 and 2 aligned in the front and on the back. However it is needless to mention that the scope of the invention is by no means defined to the dual needle-bed flat-knitting machine, but the scope of the invention is also applicable to a single needle-bed flat knitting machine as well.

The above embodiment has solely introduced a linear spring as energizing means for depressing and energizing the sinker-loop pressing hook portion. However, it is of course possible for the invention to form the energizing means with a coil spring in place of the linear spring.

EFFECT OF THE INVENTION

As was fully described above, according to the improved flat knitting machine incorporating the inventive movable yarn guide members, each sinker loop is depressed by energizing force of an elastically energizing means at sink-loop pressing hook portion of the movable sinker. Even when sinker loop is quite small or tenion of the sinker loop is abnormally intensified while making a relative shift of the front and rear needle beds or the purpose of forming desired pattern or increasing or decreasing mesh and making arrangement to shift mesh in the forward dor backward ddiection, the energizing means bends in the direction of loosening tension of the sinker loop to prevent the sinker loop from being elongated or torn off. Relative to this arrangement, the yarn guide member and an operating knitting needle are driven forward by a predetermined amount by cams of the carriage. When laterally viewed, tip end of the slider remains without projecting itself towards the hook from the guide surface of the yarn guide member at the yarn feeding position at which the hook of the slider of the knitting needle remain open. Since the supplied knitting yarn is guided via guide surface and securely delivered to the hook, kitting yarn can be prevented from piercing tthe slider linearly proceeding to close the hook of the knitting needle or from being caught by the slider. In consequence, the improved flat knitting machine can securely form a beautiful knit having well-prepared loop length.

Furthermore, upper half portion of a lateral surface close to tip portion of the needle plate is thinly

formed. Semicircular recess is formed in the lower half portion of thick part at substanially the intermediate position of the thinly formed portion. Rotation support member of the sinker plate is held in he semicircular recess. Knitting needles are stored in layers in sslit-like space formed below the needle-plate spacers at lower half portion of a side of the needle plate. This arrangement provides advantage in that the sinker, the yarn guide member, and the knitting needles can be installed compactly in narrow space between respective needle plates.

Furthermore, since the cam groove of the control cam is formed so that the yarn guide member proceeded to the maximum extent can be prevented from overrunning the center line of teeth apertures of the needle beds disposed in the front and rear alignment, the front and rear needle beds can make shift relative to each other without causing the yarn guide members of the front and rear needle beds to interfer with each other, and yet, satisfactory knit composition can be maintained without spoiling proper function of the yarn guide meember, thus providing additional advantage.

Furthemore, when the yarn guide member is driven forward and passes by the yarn feeding aperture of the yarn feeder, tip of the yarn guide member proceeds and retreats without interferring with the yarn feeding aperture. As a result, the yarn feeding aperture is free from coming into contact with the yarn guide member, thus preventing unwanted damage otherwise caused by contact between the yarn guide member and the yarn feeding apertures of the yarn feeder from ocurrence to result in the greatly improved durability of the flat knitting machine.

Claims

1. A flat knitting machine incorporating movable yarn guide members comprising:

   at least a pair of needle beds disposed in front and rear alignment;

   a plurality of needle plates provided for each needle bed at equal intervals;

   wherein the at least pair of needle beds are disposed in front and rear alignment so that said tip portions of the needle plates are close to each other,

   a plurality of knitting needles aligned in parallel between the needle plated;

   wherein the knitting needles are compound needles in which sliders are projecting and retracing via a carriage,

   a plurality of movable sinkers each of which is swingably held at a position close to tip end of each needle plate and is provided with an elastically energizing member for generating energizing force by which a knitting yarn held in knitting-yarn pressing portion formed at tip portion of each movable sinker is energized in the direction of pressing knitting yarn; characterized in that:

   each yarn guide member is provided between a needle plate and a knitting needle, wherein each yarn guide member is slidably disposed so that guide surface formed at the tip thereof can project and retract itself from the tip of each needle bed; and

   an operating member is provided at rear-end portion of each yarn guide member and projecting and retracting by a control means secured to a carriage.

2. A flat knitting machine incorporating movable yarn guide members as claimed in claim 1, wherein

   upper half of lateral surface close to the tip of each needle plate is thinly formed, semispherical supporting recess is formed in thick lower half portion substantially at the middle of the thinly formed lateral surface thereof, a rotary support member of a movable sinker is engaged with the semispherical supporting recess, each yarn guiding member is slidably positioned at lateral portion of the rotary support member, and a knitting needle is stored in slit-like space formed below a needle plate spacer at the lower half portion of lateral surface of the needle plate.

3. A flat knitting machine incorporating movable yarn guide members as claimed in claim 1 or 2, wherein

   cam groove of a control cam is formed in order that each yarn guide member will not overrun the center line of teeth apertures of the needle beds provided in the front and rear alignment when the yarn guide members are driven to the farthest position.

4. A flat knitting machine incorporating movable yarn guide members as claimed in claim 1, 2 or 3, wherein

   cam groove of a control cam is formed so that the tip of the yarn guide member retreats to a position free from causing interference with yarn supply aperture while yarn supply aperture of a yarn feeder passes therethrouth only when the yarn guide member is driven in the forward direction.

Fig.1

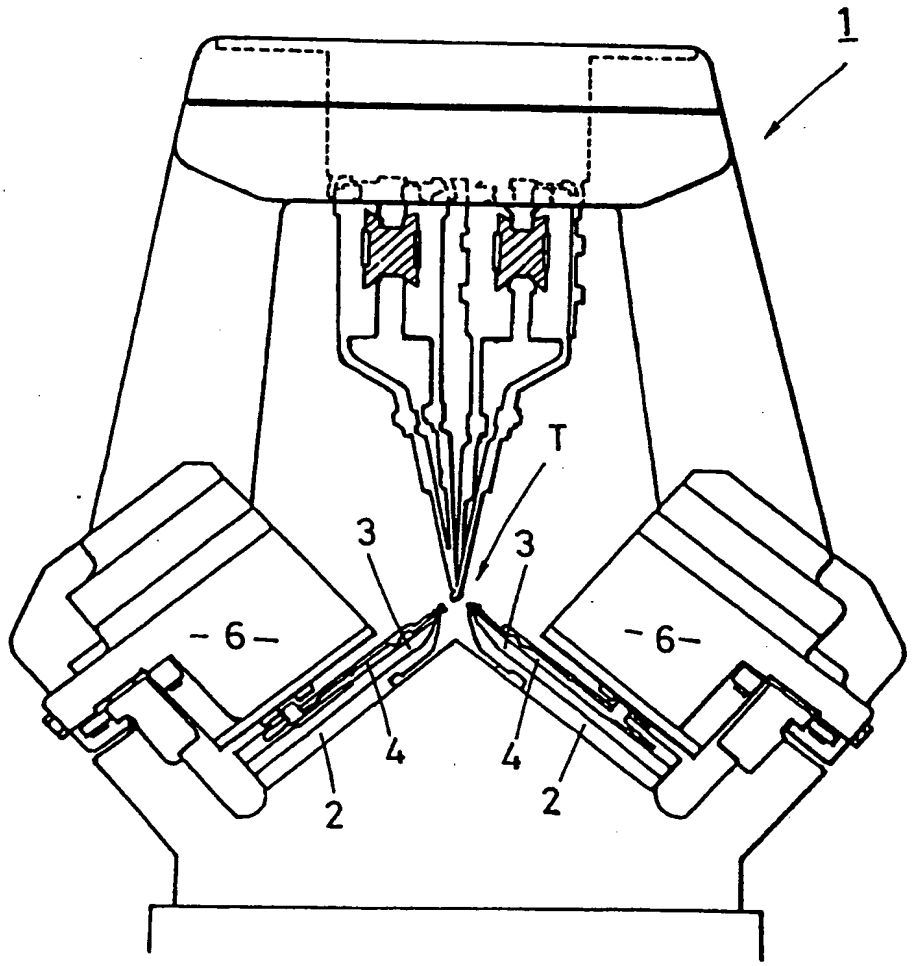
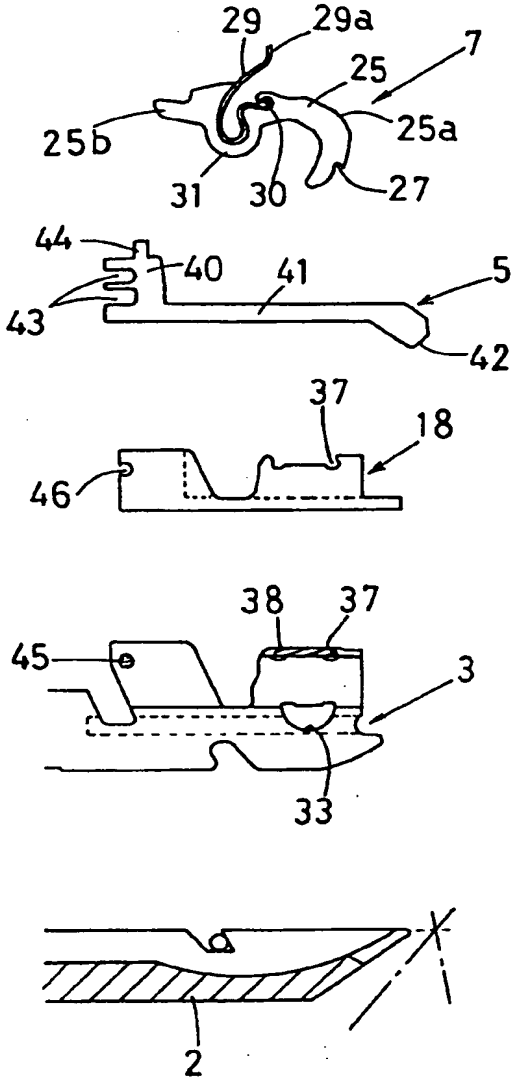


Fig.2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25b
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Fig.3

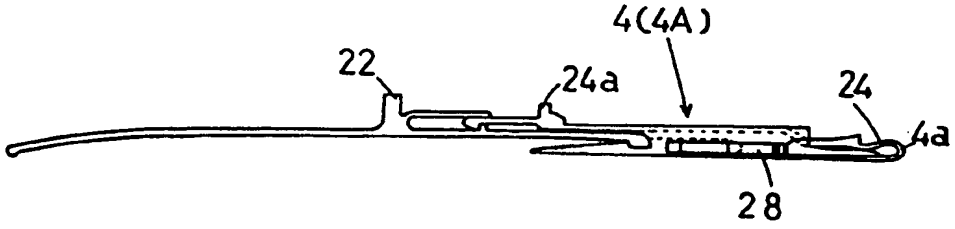

4(4A)
22
24a
24
4a
28

Fig.4

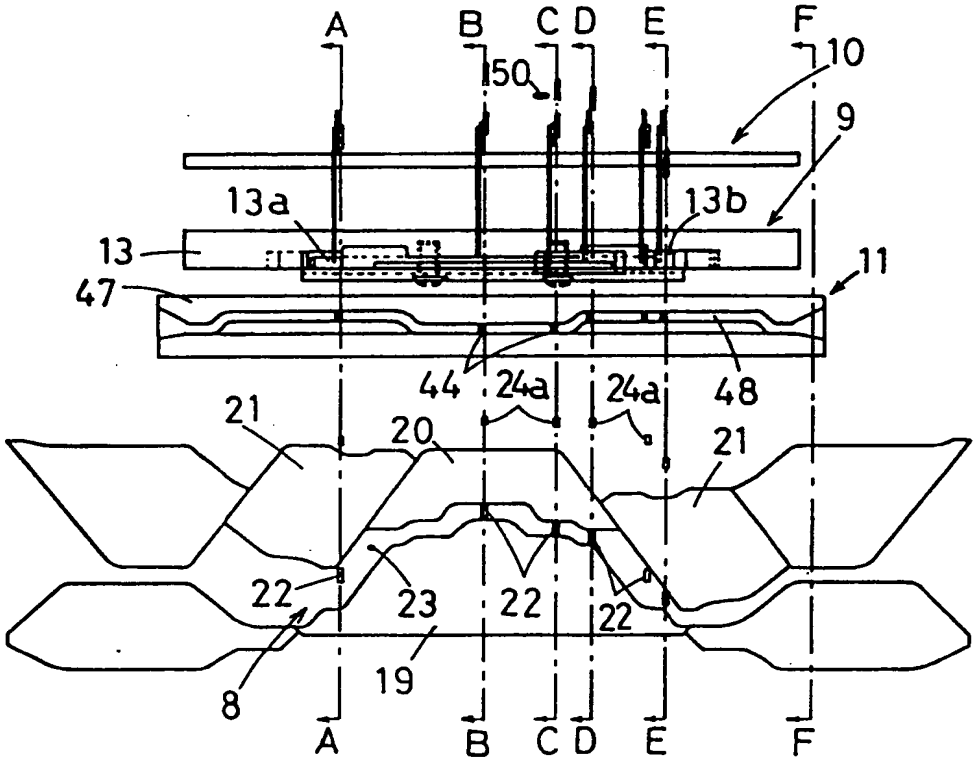

A
B
C
D
E
F
10
150
9
13a
13b
13
11
47
44
24a
24a
48
21
20
21
22
23
22
22
19
8
A
B
C
D
E
F

Fig.5

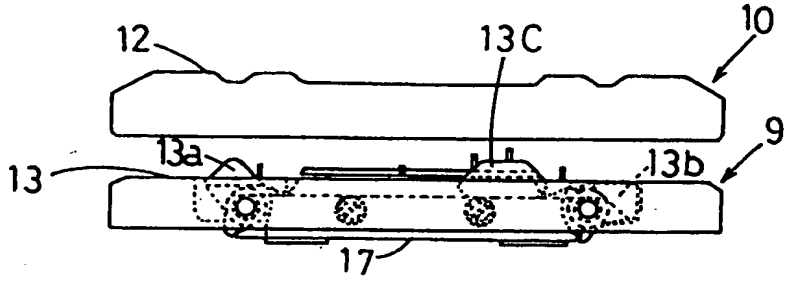

12
13C
10
9
13a
13
13b
17

Fig. 6

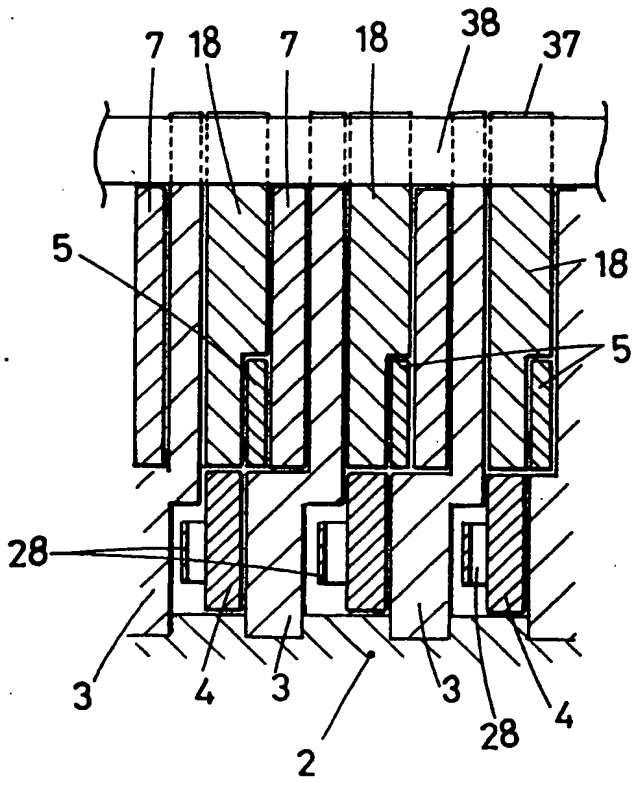


Fig.7

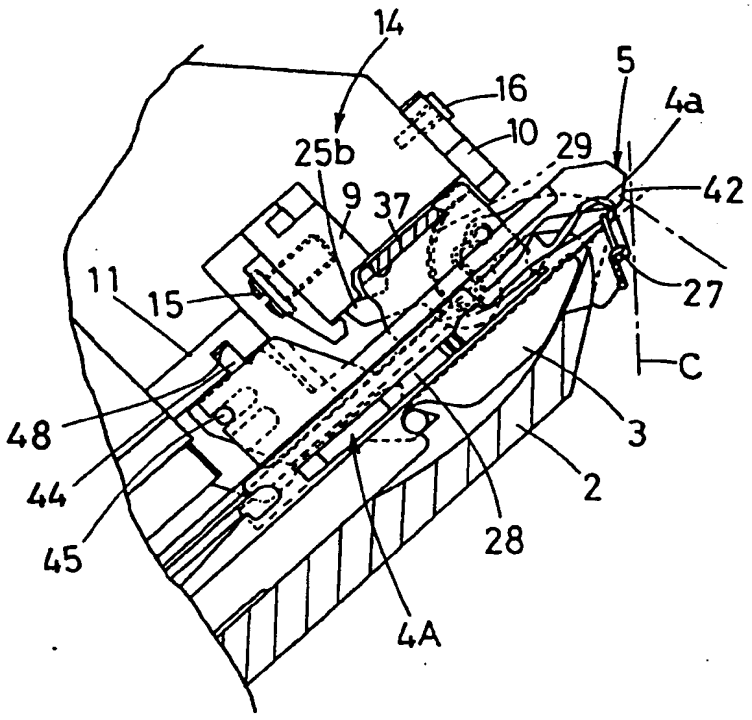

14
16
5
4a
10
29
25b
9
37
42
11
15
27
C
48
3
44
2
28
45
4A

Fig.8

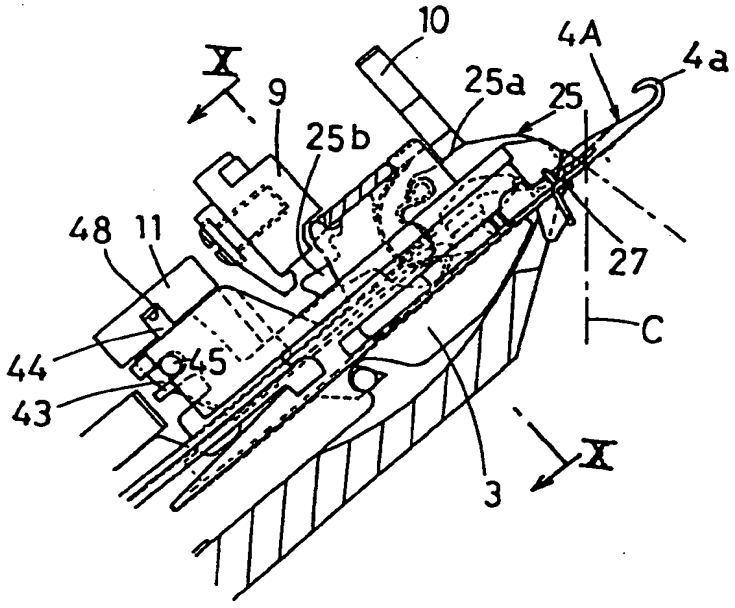

10
4A
4a
X
9
25a
25
25b
48
11
27
C
44
45
43
3
X

Fig.11

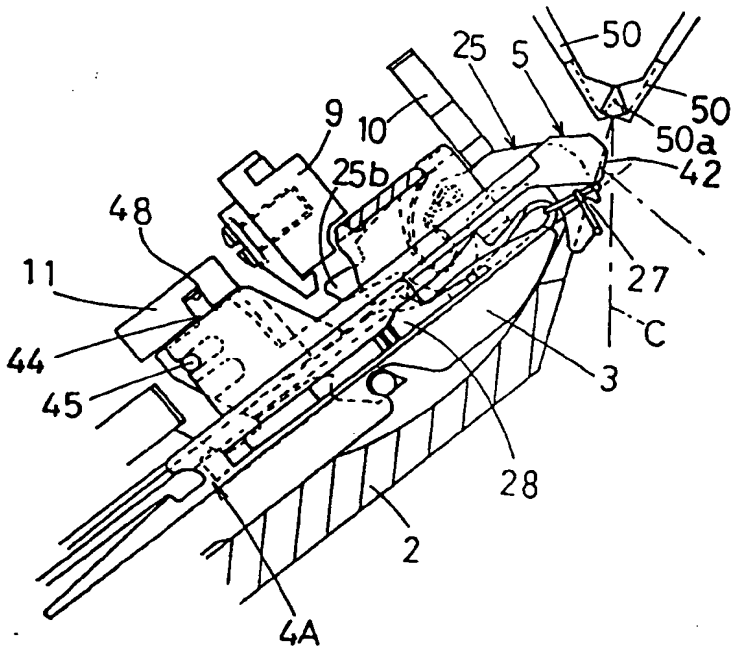
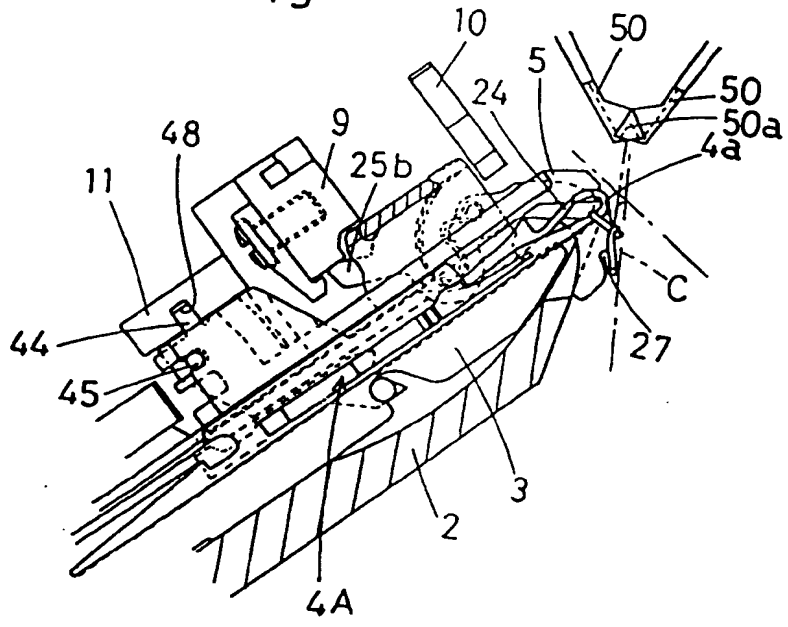

25
5
50
50
50a
42
9
10
25b
48
11
27
C
44
3
45
28
2
4A

Fig.12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50
5
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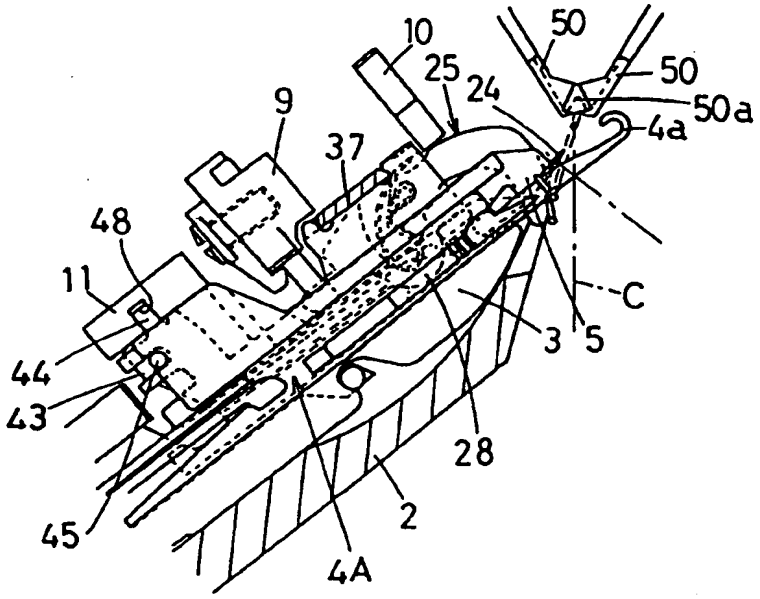
50a
4a
48
9
25b
11
C
44
27
45
3
2
4A

Fig.9


10
50
25
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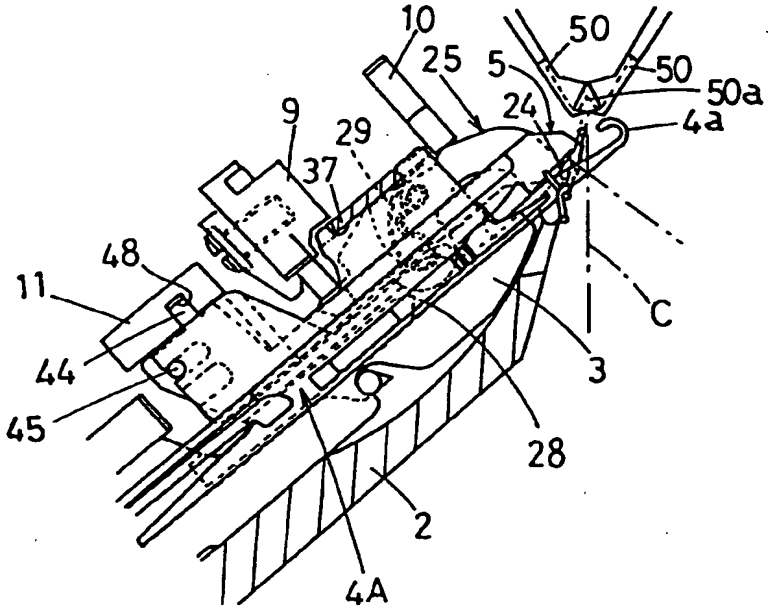
24
50a
9
4a
37
48
11
C
3
5
44
43
28
2
45
4A

Fig.10


10
50
25
5
50
50a
24
4a
9
29
37
48
11
C
44
3
45
28
2
4A

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 1744

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 578 458 (SHIMA SEIKI MFG., LTD.)		D04B15/06
D,A	EP-A-0 441 564 (SHIMA SEIKI MFG., LTD.)		
D,A	EP-A-0 435 690 (SHIMA SEIKI MFG., LTD.)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 July 1995	Van Gelder, P

CATEGORY OF CITED DOCUMENTS

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